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DEPARTMENT OF COMMERCE

UNITED STATES BUREAU OF MINES
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INFORMATION CIRCULAR

METHOD AND COST OF EXPLORING, EQUIPPING FOR DEVELOPMENT, AND DEVELOPING THE CENTRAL PATRICIA GROUP OF CLAIMS, NORTHERN ONTARIO

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A. J. KEAST AND CHAS. F. JACKSON

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METHOD AND COST OF EXPLORING, EQUIPPING FOR DEVELOPMENT, AND DEVELOPING THE CENTRAL PATRICIA GROUP OF CLAIMS, NORTHERN ONTARIO[1]

By A. J. Keast[2], and Chas. F. Jackson[3]

INTRODUCTION

This circular is one of a series dealing with the exploration, equipping, and development of mining properties, prepared and published by the United States Bureau of Mines in cooperation with various mining and exploration companies in the United States and Canada. This series of papers will supplement an earlier one which covered the methods and costs of mining and milling at a large number of producing mines.

The present paper describes the exploration, equipping, and developing of a group of 18 claims remote from rail transportation, and the transport of equipment and heavy supplies for a distance of 120 miles by tractor over ice and winter roads, and of men and lighter supplies by airplane.

Development was carried to a depth of 500 feet, disclosing 33,155 tons of ore of an estimated average value of $13.71 in gold per ton or a gross value of $454,555; and 12,000 tons of "possible" ore of an estimated average value of $12 per ton in gold.[4] Upon completion of this work, operations were suspended, and therefore the data presented in this paper do not include the construction of a milling plant which would be required to put the property on a production basis.

ACKNOWLEDGMENTS

The information contained in this paper was secured through the courtesy of W. E. Segsworth, Consulting Engineer of Central Patricia Mines (Ltd.), who, together with A. J. Keast, Mine Manager, compiled the operating and cost data.

Notes on the geology and the maps and cross sections have been taken from volume 39, part 2, 1930, of the thirty-ninth annual report of the Ontario Department of Mines.

LOCATION OF PROPERTY

The Central Patricia property is in the Patricia section of the Pickle Lake-Crow River area, district of Kenora, about 100 miles north of Savant Lake station on the Canadian National Railway. (See key map, fig. 1.) The 18 surveyed mining claims comprised in the property are 2 miles northeast of Pickle Lake and occupy ground on both sides of Crow River (fig. 2). The area is flat, largely covered by muskeg and somewhat higher sand plains, and

1 - The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6681."

2 - Formerly mine manager, Central Patricia Mines (Ltd.).

3 - Principal mining engineer, U. S. Bureau of Mines.

4 - Ontario Department of Mines, Thirty-ninth Annual Report: Vol. 39, 1930, Part 2, pp. 24-25.

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shows scattered rock outcrops. A growth of spruce and jack pine covers a considerable portion of the claims.

The growing season in the district is short. During July the weather is apt to be dry and hot, while frosts may be expected up to early June and again after the middle of August. Winters are typical of northern Ontario. Most of the area is well forested. The muskeg areas support a rather dense growth of spruce. Tamarack is found in the wetter and more open swamps, and along lake shores stunted cedars are plentiful. The high ground is covered by poplar, spruce, pine, and occasionally birch.

Fish and game are remarkably scarce in this region and can not be relied upon as a source of food supply.

From the foregoing, it is evident that a plentiful supply of timber is available for fuel, saw lumber and mine supports, but that all foodstuffs must be shipped in from outside the district.

TRANSPORTATION

As previously stated, the district lies about 100 miles in a northerly direction from Savant Lake, which is on the Canadian National Railway.

Means of Access to District.- The district may be reached by canoe from Hudson, which is also on the Canadian National Railway, in from five to eight days. (See map, fig. 1.) There are 10 portages having a total length of 1¼ miles between Hudson and the west end of Lake St. Joseph. Another route leaves the railroad a mile east of Savant Lake, crosses into Savant Lake, and follows the Savant and Pashkokogan rivers to Lake St. Joseph. From Lake St. Joseph the route leaves the east end of the lake via Doghole, Annimwash, Kasagiminnis, Ochig, and Wimbabika Lakes and goes to Pickle Lake, involving eight portages which total 2¾ miles.[5]

The water trip is long and arduous, and all heavy transportation to the Central Patricia Mines (Ltd.) property was by means of tractor trains over ice and winter roads, while transportation of men and of some supplies was by airplane. No water transportation was employed. The tractor route from Savant Lake, at which a base was established, was 120 miles long. Some clearing, including a stretch of 3 miles between the mine and Pickle Lake, had to be done to facilitate winter hauling.

The air trip is about 100 miles long, and landing is made on the lake 3 miles from the mine. The trip from the lake to the mine is by wagon or tractor. There is a flat area near the mine which could be cleared and utilized for a landing field in winter time. The airplanes which have proved most satisfactory carry about 1,500 pounds per trip. Larger planes, carrying up to 3 tons, have so far not proved as practicable as the smaller planes. Supplies can now be flown in for about 4½ cents per pound, though previously rates were much higher. The regular rate for carrying passengers by air was about $50 one way and for a round trip was $85. By guaranteeing a certain minimum amount of business considerably lower rates were secured.

Tractor Haulage.- Although one tractor was purchased by the company, it is assumed, for the sake of simplifying the cost estimates, that all the tractors were rented, since the rest of the tractors were actually procured from Winnipeg on a rental basis.

The first trip into the mine left Savant Lake on January 12, 1930, carrying only a light load, and was made chiefly for the purpose of breaking the road. Approximately 400 tons of mining machinery and supplies were transported in five round trips requiring about 12 days per round trip. Therefore the average load per trip was 80 tons.

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5 - Ontario Department of Mines, Thirty-ninth Annual Report, vol. 39, part 2, 1930, 65 pp.

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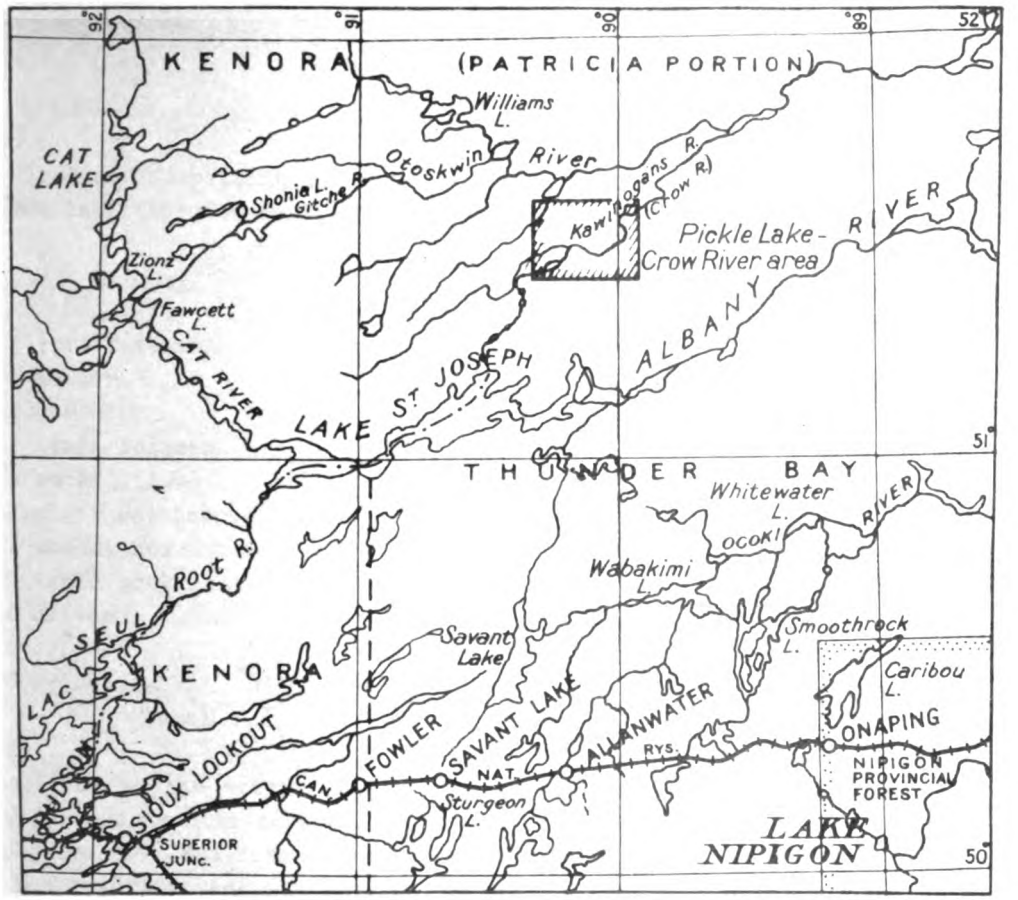

Figure 1.- Key map showing location of the Pickle Lake-Crow River area (after Ontario Department of Mines)

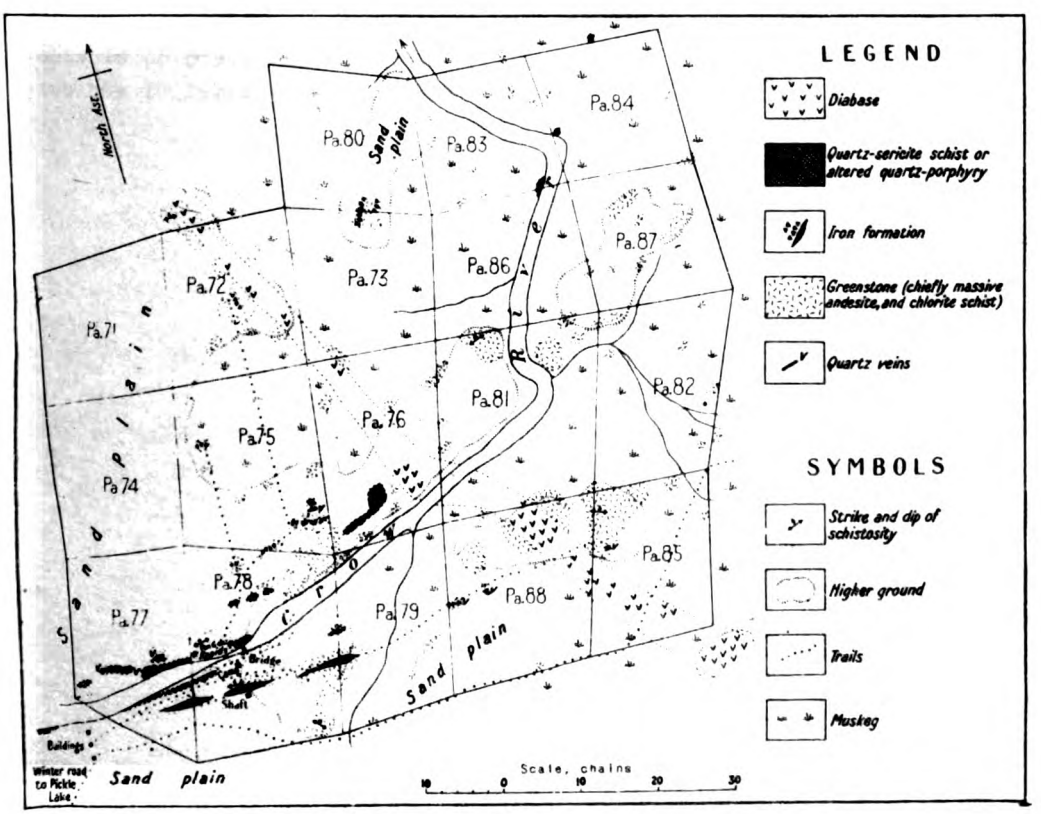

Figure 2.- Preliminary geological map of the Central Patricia Mines group (after Ontario Department of Mines)

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The first men comprising the transport crew arrived at Savant Lake on November 10, and the last men left there on April 10. The transport crew and wages received were as follows:

	Wage per month	Board included, months	Wage per year
1 yard foreman....	$200	5	$1,180
1 loader.....	175	4	844
1 clerk.....	100	4	544
1 train foreman..	200	3	708
1 cook.....	60	5	480
1 night watchman	60	5	480
1 woodcutter.....	75	3	333
1 train cook.....	60	3½	336
6 drivers.....	150	3½	3,906
2 drivers.....	150	4	1,488
5 drivers.....	150	3	2,790
Total			13,089

In addition to the tractor equipment, 24 sleighs and a snow plow were purchased and made ready for use and two cabooses were constructed to serve for traveling cook house and commissary purposes. Buildings already erected at Savant Lake were rented and extra buildings were built for storage and camp purposes.

The foregoing figures, together with those immediately following, were prepared by A. J. Keast and are in part estimates based on verbal reports and his own personal observations. Since the transportation costs were absorbed in the figures covering plant, equipment, and operation costs to be presented subsequently, and which are actual costs, any slight errors in the figures now following will not affect the accuracy of the plant and other costs.

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Cost of transporting 400 tons of mining equipment and supplies 120 miles by tractors

Labor and board as given above		$13,089
Return trip fares for 20 men, Winnipeg to Savant Lake		432
Lumber, roofing paper, etc., for extra buildings		350
Storage tent		150
Twenty-four sleighs at $165 each		3,960
Material for sleigh racks, iron chain, etc.		150
Local labor employed at Savant Lake		125
Travel expense, manager of freighting company		65
Rent of buildings at Savant Lake, five months		250
Lumber and labor for making two cabooses		200
Gasoline used on first trip, 1,000 gallons		245
Gasoline used on five later trips, 9,000 gallons		2,205
Oil, antifreeze, etc.		500
Tractor repairs, estimated		700
Other repairs, losses, and incidentals		500
Total		22,921
Rent of Tractors:		
One 20-hp., 120 days at $8	$960	
One 20-hp., 90 days at $8	720	
One 30-hp., 120 days at $12	1,440	
Two 30-hp., 75 days at $24	1,800	
Two 60-hp., 75 days at $30	2,250	
Freight on tractors	873	
New snow plow	3,000	
Total, tractors and snow plow		11,043
Grand total		33,964

The foregoing figures do not include insurance on equipment and supplies carried, Winnipeg administration costs, or such items. Mr. Keast is of the opinion that labor charges could have been less than they were, since no particular effort was made to economize in this respect, the time element having been of primary importance. On the basis of the foregoing figures, unit transportation costs are calculated approximately as follows:

Unit costs of transportation

Labor, per ton of freight hauled	$32.72
Savant Lake expense, travel expense, materials, gasoline, tractor repairs, etc., per ton of freight	24.58
Tractor rent, freight on tractors, and snow plow cost	27.61
Total cost per ton of freight hauled	84.91
Labor per ton-mile inbound with load	273
Savant Lake expense, etc., per ton-mile inbound	.205
Tractor rent and freight, and snow plow per ton-mile inbound	.230
Total cost per ton-mile inbound	0.708

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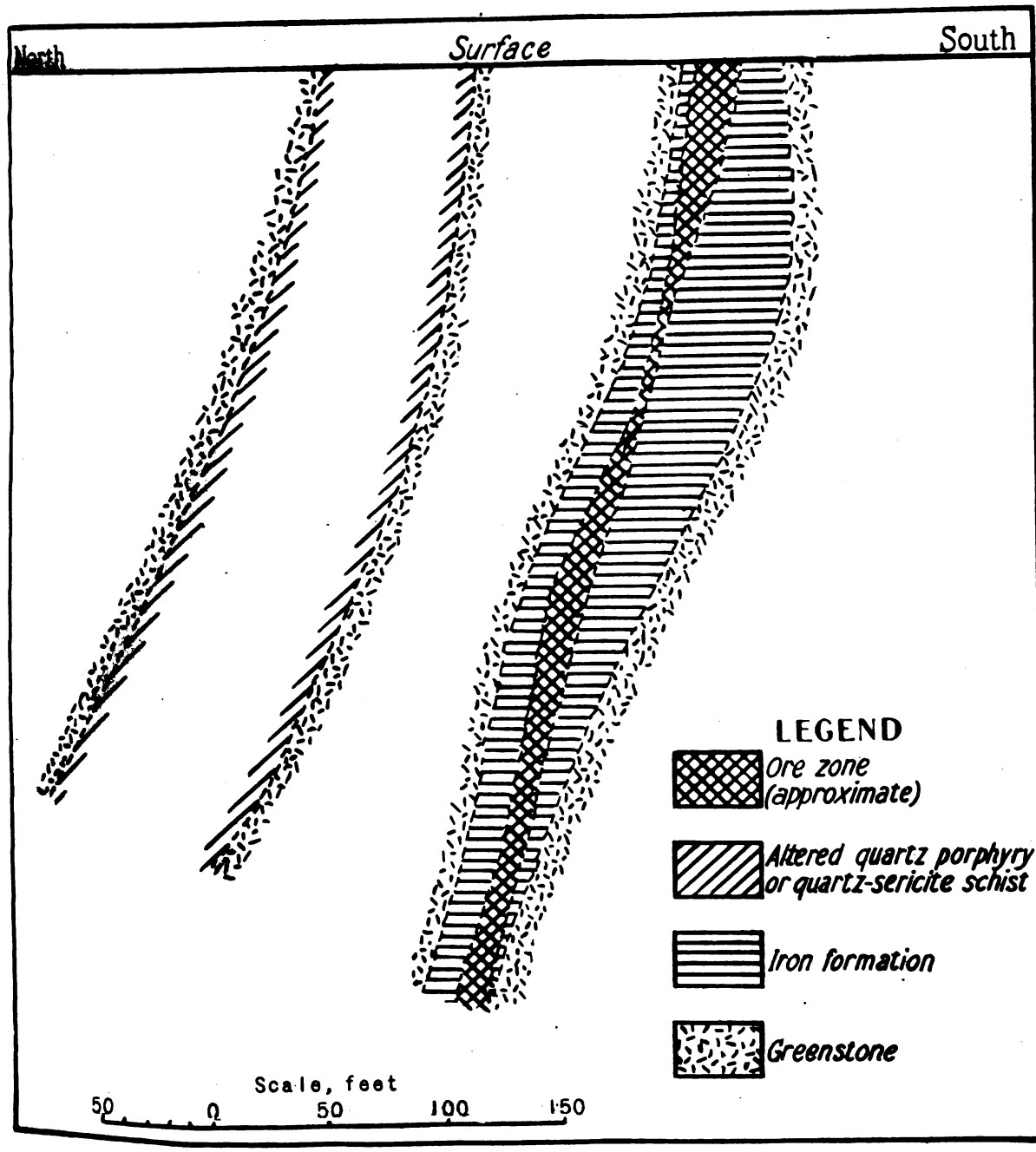

Figure 3.- Structure section showing geological relationships across the principal ore zone, Central Patricia Mines (after Ontario Department of Mines)

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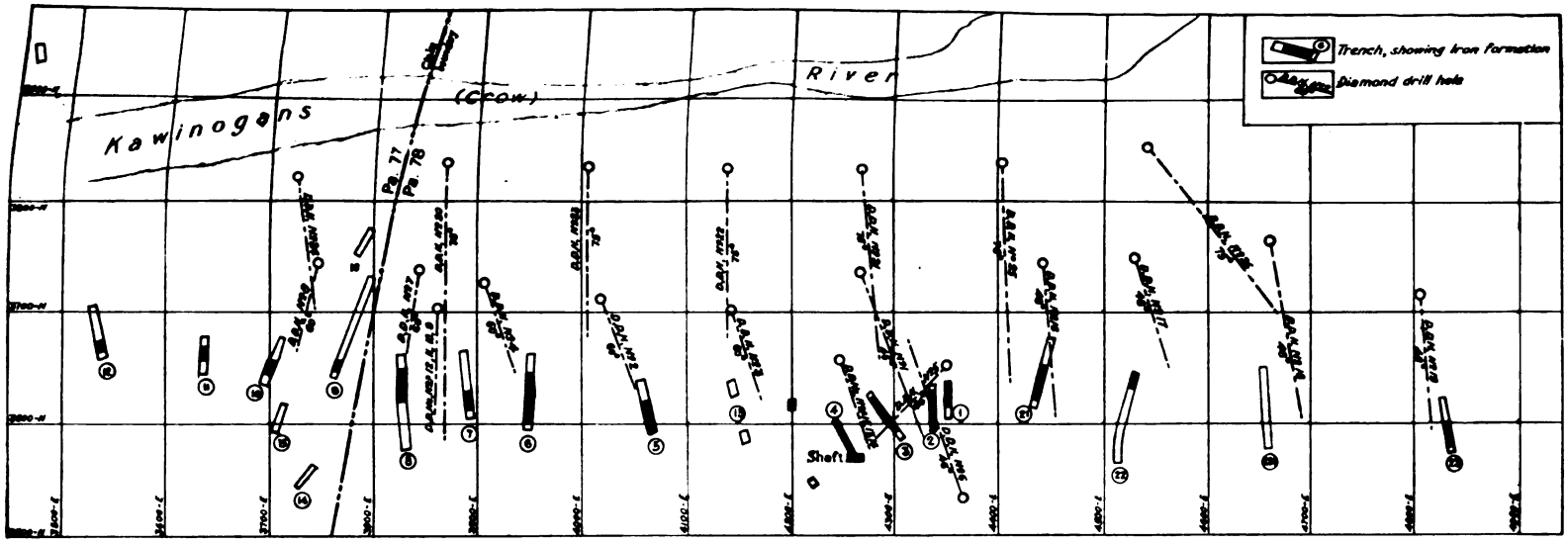
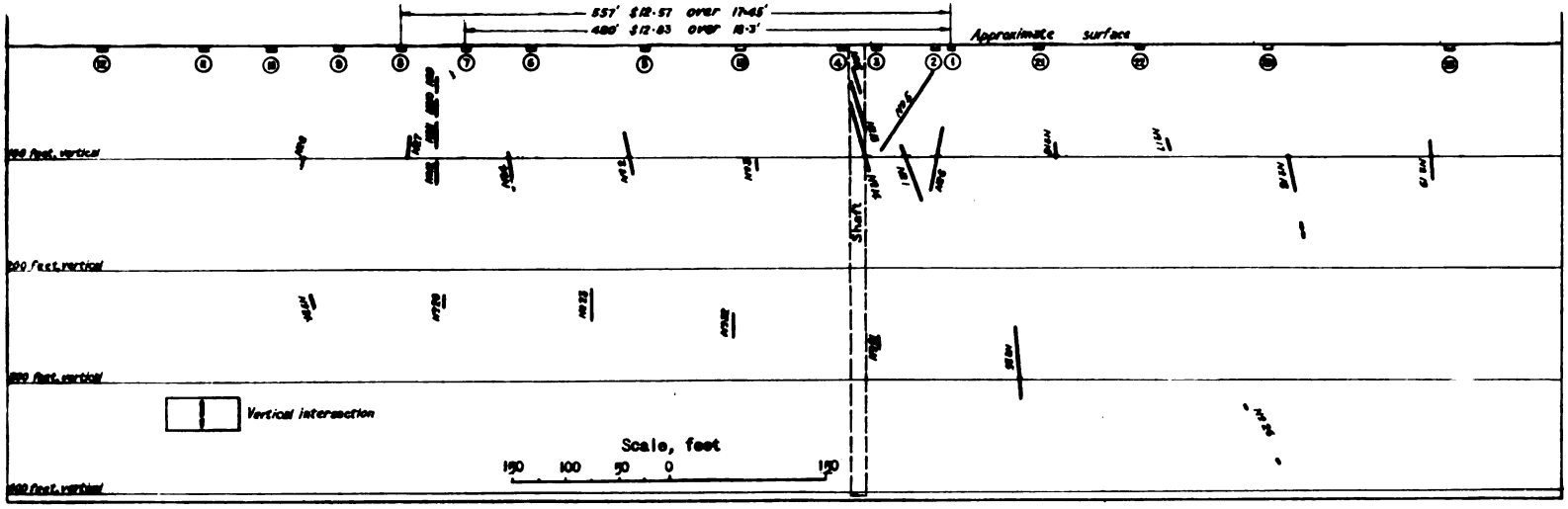


PLAN



SECTION

Figure 4.- Plan and section showing trenching and diamond drilling, Central Patricia Mines (after Ontario Department of Mines)

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It is obvious that water transportation of freight is impracticable in this district. If freighting by plane can now be done for 4½ cents per pound, or $90 per ton, there is only a small indicated difference in cost between freighting by tractor and by plane. At the time the freight was taken into the Central Patricia property, however, airplane freighting costs were much higher. Furthermore, the weight and size of individual pieces is limited in the case of airplane transportation, so that the larger and heavier pieces would have to be taken in by tractor in any event.

At the time of writing (October, 1932), costs have come down to such an extent that it is estimated that freighting to the mine could be contracted for at from $50 to $60 per ton.

GENERAL FEATURES OF MINING PROPERTY

The following notes have been abstracted from the report of the Ontario Department of Mines which has already been referred to. Natural surface features are illustrated in Figure 2, and both Figure 2 and 3 show the general geological features and the orebodies. These illustrations have been taken from the same report.

The country rock consists chiefly of Keewatin greenstones, schists, and occasional bands of iron formation. Irregular bodies of altered quartz porphyry or quartz-sericite schist outcrop to the north of the principal ore zone and on both sides of the Crow River. These bodies appear to be conformable in strike and dip with the enclosing greenstones and exhibit similar schistosity. A prominent diabase dike, 100 to 300 feet wide, intersects the Keewatin rocks and crosses the property from northwest to southeast.

Patches of iron formation, quartz veins, and other evidences of mineralization have been found on various parts of the property. The most important deposit, and the one on which development work has been concentrated, is just south of Crow River on claims Pa. 77 and Pa. 78. This deposit occurs along a fracture zone within a band of iron carbonate formation lying in the Keewatin greenstones and trends slightly north of east. This band is not uniform in width or continuity, but consists rather of several lenticular bodies which do not lie exactly along the same line of strike but are slightly offset in relation to one another. They attain a width of 50 feet in places and each extends about 400 feet along the strike before being displaced or pinching out. The iron carbonate formation has been traced by trenching for about 1,800 feet. The zone of fracturing and mineralization runs approximately east-west and intersects the lenses of iron formation at a low angle. It is cut off by a fault at the east end; at the west end, where it passes into the greenstones, there is a marked decrease in the mineralization.

The relationships of the ore zone and of the various rock formations, as indicated by diamond drilling, are shown on the structure section, Figure 3. The mineralized zone and the enclosing iron formation dip at an angle of 75° to the north.

PRELIMINARY EXPLORATION OF PROPERTY

Preliminary exploration work consisted of trenching followed by diamond drilling. Figure 4, taken from the report of the Ontario Department of Mines, shows the location and extent of this work. The average depth of overburden removed in trenching was about 5 feet. A rough estimate of the amount of trenching done as scaled from the map indicates that a total of about 1,050 linear feet of trenches were dug. Diamond-drill exploration comprised 30 holes, totaling 6,000 feet of drilling. This work was done on contract, log camps being built at the expense of the drilling contractor for housing the drill crews.

The cost of the preliminary exploration, location and surveying of claims, trenching, and 6,000 feet of diamond drilling was $60,280, as revealed by the balance sheet of September 20, 1930.

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HISTORY OF OPERATIONS

The main ore zone was explored by diamond drilling during the summer of 1929, under the direction of J. C. Kirkland. In the fall of that year, following the appointment of W. E. Segsworth as consulting engineer and of A. J. Keast as mine manager, an ample supply of cordwood was cut, logs were cut ready for sawing into lumber at such time as a sawmill could be brought in and placed in operation, and a shaft was sunk by hand to a depth of 30 feet. About January 20, 1930, the first tractor came in with the sawmill and some other equipment and supplies. The sawmill was immediately erected and sawing of lumber commenced. Camp construction started about February 1, and by April 2 the buildings were ready. Shaft sinking was resumed below 30 feet on March 5, using a hoist and a regular sawed-timber headframe. By July 1, the shaft was down 527 feet and four shaft stations had been cut. At the end of August, 1930, approximately 2,800 feet of lateral development had been completed.

UNDERGROUND EXPLORATION AND DEVELOPMENT

Construction and Equipment of Camp.- Preparatory work was begun in October, 1929, after the diamond drilling had been completed. This work consisted of cutting out the Savant and Pickle Lake winter roads, clearing an area of about 100 acres (fig. 5), and cutting cordwood and saw logs. Expenditure for clearing land was $2,696, for the Savant winter road $4,243, and for the Pickle Lake road $118, a total of $7,057. The crew employed on this work lived in the log camps already constructed. On January 20, 1930, the purchased tractor arrived with the sawmill and sawing of lumber was begun by using the tractor to drive the sawmill until steam power was available. Construction of a permanent camp began about February 1, and by April 2 the buildings were up and a power plant had been installed ready for operation. Figure 5 shows the camp and plant layout. Below are given the approximate sizes and costs of the camp buildings. This camp accommodated 60 men.

Sizes and costs of camp buildings

	Approximate size, feet	Cost
Bunkhouse 1	18 x 20	$218
Bunkhouse 2	20 x 30	875
Bunkhouse 3	16 x 18	155
Bunkhouse 4	32 x 20	316
Cookery	50 x 24	1,694
Residence 1	24 x 24	766
Storehouse 1	20 x 40	701
Storehouse 2	18 x 24	252
Two small root houses	-	854
Meat house	24 x 30	613
Ice house	12 x 14	115
Total, camp buildings		6,559

Camp Equipment.- The cost of equipment for sleeping quarters and cookery is summarized as follows:

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	Cost
Bunkhouse 1	$246
Bunkhouse 2	1,155
Bunkhouse 3	76
Bunkhouse 4	258
Cookery	513
Residence 1	39
Total, camp equipment	2,287

Provisioning of Camp.- Provisions were brought in for the most part by tractor in the wintertime and included a year's supply of canned and smoked meat. Fresh meat and green food were taken in by airplanes during the following summer.

Construction and Equipment of Plant.- The purchased tractor was employed for moving logs, lumber, and equipment in camp, and it is estimated that this machine accomplished as much work as could have been done by seven to ten teams. Buildings were constructed of lumber sawed on the job, and thus only hardware, millwork, glass, and roof covering had to be brought in from outside.

Following is a list of the plant buildings with their cost and approximate dimensions:

Cost and approximate dimensions of plant buildings

Building	Approximate size, feet	Cost
Blacksmith shop	20 x 28	$673
Power house and hoist room	80 x 28	2,115
Dry house	18 x 28	854
Assay office	16 x 28	630
Office and storehouse	24 x 28	1,060
Powder magazine	18 x 30	633
Thaw house	8 x 10	196
Cap and fuse house	8 x 10	157
Pump house	8 x 10	133
Water tank	10,000 gallons	541
Stable	10 x 10	176
Old drafting office	6 x 18	220
Tractor house (garage)	10 x 16	285
Headframe (40 feet high)		1,411
Total, plant buildings		9,084

Buildings were framed on 2 by 4 inch studdings, sills, and rafters and were covered by a layer of good-grade roofing. All the above costs include freight and the cost of haulage to the mine.

Plant Equipment.- Steam power generated by two wood-fired, 110-hp., horizontal, return-tubular boilers was used for hoisting, pumping, and air compression. The hoist was a second-hand machine which originally had 12 by 15 inch cylinders, but these were bushed down to 10 by 12 inches. The plant was designed outside and all piping was cut and fitted outside and sent in ready to install. The compressor delivered 750 cubic feet of free air per minute at 100 pounds pressure and ran four drifting machines and the drill sharpener.

A telephone line was built to a Government radio station at a forestry service camp 4 miles away, so that communication to the outside world was possible during certain hours of

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the day. This line was laid under water for a distance of 1 mile and on land for the other 3 miles.

Sand and gravel for making concrete were available on the property.

Following is a list of the plant equipment, with costs of the various items which include freight, hauling, and installation.

Plant equipment

Office and storehouse equipment and supplies	$498
Stable	441
Blacksmith shop:	
Tools	380
Forges and furnaces	53
Steel sharpener	2,553
Power-house tools	128
Hoist (except foundations)	5,616
Hoist foundations	1,089
Compressor (except foundations)	11,150
Compressor foundations	2,165
Boilers (except foundations)	13,409
Boiler foundations	1,606
Dry equipment	157
Assay office	1,641
Sawmill	2,228
Carpenter's tools	24
Miscellaneous surface tools	446
Diamond drill	4,949
Surface pipe lines	1,609
Surface tracks	559
Surface pumps	944
Electric-light plant	1,083
Electric-light plant foundations	146
Transportation equipment	308
Tractor, 30 caterpillar	4,337
Feed-water heater and pumps	1,643
Feed-water heater and pump foundations	154
Headframe equipment	272
Telephone line	1,259
Total, surface plant equipment	60,847

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Underground equipment

Four 3½-inch leyner-type rock drills	3,100	
Drill steel (7 tons, 1-inch, quarter octagon)	1,284	
Underground pumps	1,753	
Ten 1-ton mine cars	2,865	
Mucking sheets	452	
Two 1,800-pound sinking buckets, 2 2 cages, etc.	1,566	
Blasting equipment	57	
Total, underground equipment	11,077	
Combined surface plant and underground equipment		$71,924

Summary of costs of buildings and equipment

Camp buildings	$6,559
Camp equipment	2,287
Plant buildings	9,084
Surface plant equipment	60,847
Underground equipment	11,077
Total, buildings and equipment	89,854

SHAFT SINKING

As previously stated, the shaft was sunk to a depth of 30 feet by hand methods prior to the arrival and installation of the regular sinking equipment. Regular sinking operations began on March 5, 1930.

The shaft was divided into three compartments; two for hoisting, and one for manway and pipes. It was about 6½ by 16 feet outside the timbers and was timbered with 8 by 8 inch timber sawed at the mine. Shaft sets were spaced on 7-foot centers. The manway was separated from the hoisting compartments with 1-inch boards, and the sets were lagged on the outside with round poles as required by the nature of the ground. Hoisting compartments were 4½ by 5 feet in the clear, and the manway and pipe compartment was 3 feet 9 inches by 5 feet in the clear. The shaft was vertical and was sunk in the foot wall in greenstone. Shaft stations were cut at vertical intervals of 125 feet as the shaft reached these horizons.

Rather heavy flows of water were encountered at 250 and 280 foot depths, and while the heavy flows continued the boiler plant consumed 10 cords of fire-wood per day. By July 1 the shaft was completed to a depth of 527 feet, and included a 27-foot sump and stations at 125, 250, 375, and 500 feet.

The shaft sinking was conducted on three 8-hour shifts per day by a regular crew of six miners in the shaft, a hoistman and deckman on each shift, and a topman on day shift. Other labor included deckman's helpers during periods of mucking or timbering in the shaft, a blacksmith and helper, a fireman on each shift, and general surface labor.

The direct cost of sinking the shaft to its completed depth of 527 feet was $34,433, while apportioned general charges amounted to $6,865, or a total cost of $41,298. These figures are equivalent to $65.338 per foot direct cost, $13.026 per foot general charges, and a total cost of $78.364 per foot. Adjustments in accounts bring the total cost to $41,321 or $78.41 per foot.

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Detail of costs per foot of shaft

	Cost per foot	
Labor - direct:		
Machinemen and helpers	$9.542	
Muckers	14.016	
Total, underground direct labor	23.558	
Supplies and maintenance:		
Explosives	7.546	
Timbering	9.471	
Drill maintenance	.312	
Steel and steel sharpening	2.680	
Pipes and pipe fitting	4.634	
Miscellaneous supplies	.314	
Total, supplies and maintenance	24.957	
Other costs:		
Hoisting	4.871	
Landing and dumping	2.794	
Compressed air	5.315	
Pumping	3.249	
Lighting	.144	
Handling explosives	.051	
Operation of mine dry	.099	
Repairs to mine tools	.144	
Cars, track and maintenance	.120	
Shaft repairs	.035	
Total, other costs	16.822	
Total, all direct charges		$65.338
Proportion of general charges		13.026
Total, cost per foot of shaft		78.364

The four shaft stations, aggregating 89.3 feet in length, cost $6,084 or $68.13 per foot. A pump sump 9.5 feet deep cost $743 to excavate.

LATERAL DEVELOPMENT

Before operations were suspended in September, 1,775.7 feet of drifting and 1,019.3 feet of crosscutting were completed, a total of 2,795.0 feet of lateral development.

The cost per foot of this work is detailed as follows:

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Costs per foot of drifting and crosscutting

	Costs per foot	
	Drifting	Crosscutting
Labor, direct:		
Machinemen and helpers	$3.378	$3.536
Muckers	2.832	3.031
Total	6.210	6.567
Supplies and maintenance:		
Explosives	3.498	3.543
Timbering	-	.018
Drill maintenance	.382	.449
Cars, track, and maintenance	.373	.635
Steel and steel sharpening	1.262	1.387
Pipes and pipe fitting	.952	.654
Miscellaneous supplies and repairs	.177	.159
Shaft repairs	.034	.067
Total, supplies and maintenance	6.678	6.912
Other costs:		
Hoisting	1.142	1.420
Landing and dumping	.820	1.030
Compressed air	1.765	2.025
Sampling and assaying	.451	.433
Pumping	.800	1.210
Mine lighting	.134	.134
Handling explosives	.017	.047
Operation of mine dry	.021	.030
Repairs to mine tools	.007	.017
Total other costs	5.157	6.346
Total direct costs per foot	18.045	19.825
Proportion of general charges	3.181	4.263
Total, cost per foot	21.226	24.088

GENERAL CHARGES

General charges which were absorbed in the foregoing operating accounts totaled $30,640 or $2,785 per month, divided as follows:

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Item	Amount	Average per month
Superintendence	$5,084	$462
Travel expense	1,030	94
Stores and office	3,956	360
Clearing and roads	586	53
Fire protection	831	76
Operating camps and residence	1,840	167
Operating cookery	4,000	364
Stable	790	72
Shop charges	346	31
Engineering	1,704	155
Transportation charges	3,972	361
Workmens' compensation insurance	3,040	276
Fire insurance	2,312	210
Plant lighting	366	33
Plant heating	584	53
Plant maintenance	47	4
Medical expense	570	52
Handling freight at mine	350	32
Total	31,408	2,855
Credit commissary	768	70
Net general charges	30,640	2,785

SUMMARY OF EXPENDITURES TO DATE OF SUSPENDING OPERATIONS

Preliminary exploration (staking, surveying, trenchig, and diamond drilling)		$60,280
Cutting winter roads and clearing land for camp and plant		7,057
Buildings, plant and underground equipment		89,854
Underground exploration and development:		
Shaft, 527 feet deep	$41,321	
Four shaft stations	6,084	
Pump sump	743	
Drifting, 1,775.7 feet	37,691	
Crosscuts, 1,019.3 feet	24,553	
Surface exploration	172	
Total, underground exploration and development		110,564
Cost of closing mine; pulling pumps, track, cars, and pipes in September, 1930		1,360
Total, all expenditures charged		269,115

In addition to the above, inventory of stores on hand and paid for but not charged in the foregoing accounts, was as follows:

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Stores Inventory as of September 20, 1930

General supplies	$6,784
Pipe and fittings	2,875
Nails and spikes	472
Oils and greases	4,257
Iron and steel	354
Explosives	5,531
Drill machines and parts	4,857
Compressor parts	562
Column parts	181
Welding outfit	24
Pump parts	202
Sawmill supplies	123
Assay office supplies	447
Tractor parts	499
Electrical supplies	237
Cookery supplies	18,484
Commissary supplies	6,407
Cordwood, lumber, etc.	8,029
Total, inventory	60,325

Adding inventory to accounts charged gives a total of $329,440 expended.

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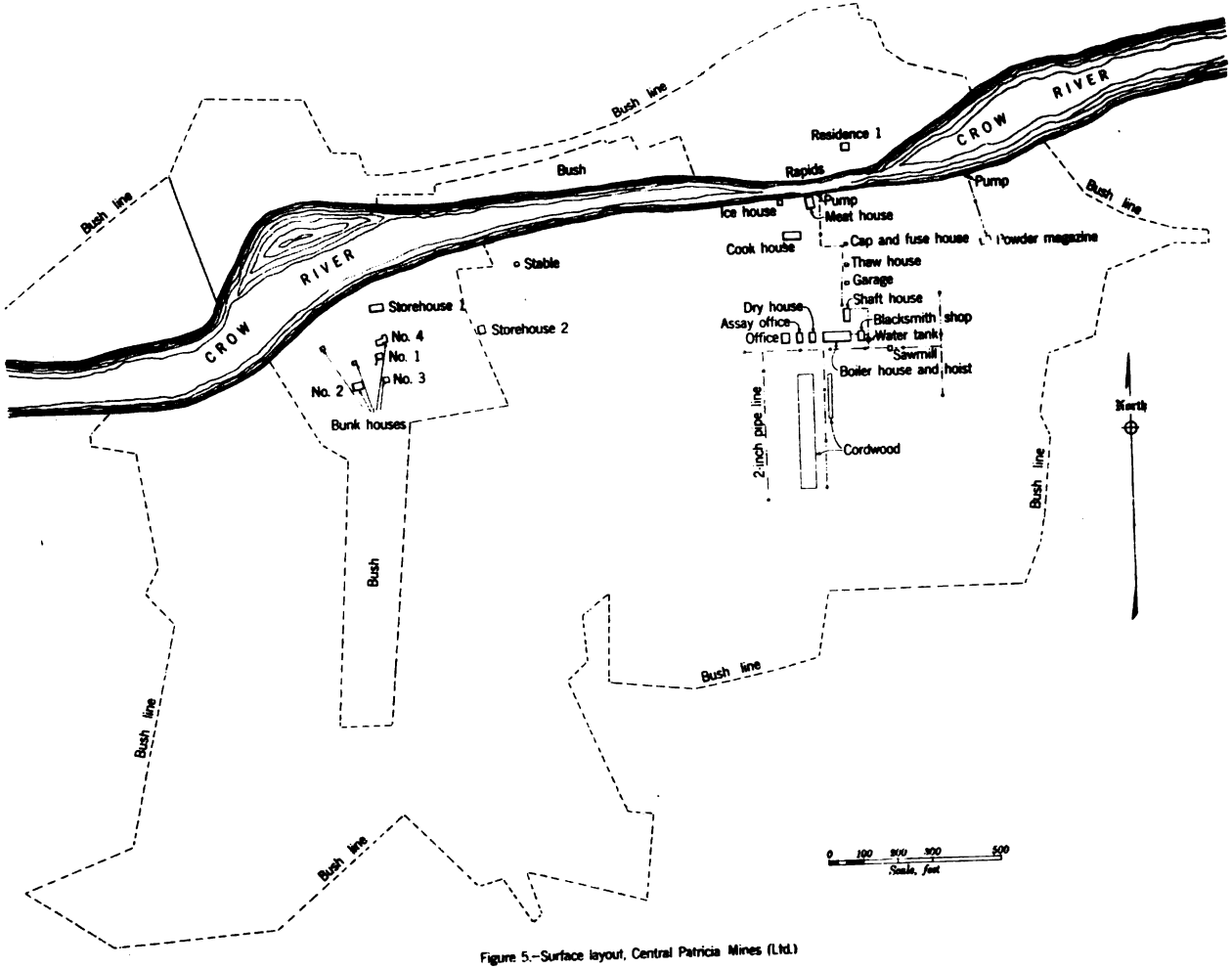

Figure 5.—Surface layout, Central Patricia Mines (Ltd.)

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